RETAINING WALLS

Retaining walls are an essential element of the modern highway system because they are the primary structure used to accomplish abrupt grade changes. In urban highway corridors, where it may not be practical to construct standard earthen embankments, wall systems are particularly useful in minimizing encroachment into adjacent developed land areas.

Retaining walls never function and never exist entirely by themselves. They almost always are part of the transportation experience. Because they often constitute a large physical presence on the landscape, their design and relationship to the environment can greatly influence the aesthetic qualities of the highway system. Therefore, it is very important that architectural and aesthetic design considerations are made early in the design process for retaining wall systems to find the best balance of solutions for the project.

Throughout the design process, many opportunities present themselves for developing a place sensitive and visually successful project. The Aesthetic Committee recognized one of these opportunities to be the design of the wall systems of the project. Members sought ways to relate the parkway design theme to the natural environment as a reflection of the community. They looked around and saw rolling hills, grasslands with scattered trees and remnant forest-prairie transitions and winding rivers that exposed what lay beneath the soil as rock outcrops. These outcrops became the design inspiration for the wall systems of the project as textured and colored concrete that would look like the rock cuts that surround the city.

Another interesting opportunity captured by the Committee was the concept that not only should the parkway be tied to the physiography of the region, but its design should also *create* street level space for the community by compressing the width of the corridor. Members queried whether preliminary retaining wall alignments could be moved closer to highway travel lanes and the space *gained* from this change transformed into attractive, park-like places *returned* to the community. As a result, the wall systems in the vicinity of the bridge crossings at 19th Street NW and between 6nd Street SW and 2nd Street SW were relocated.

Figure 3-1: Design Visualization This visualization drawing illustrates the motorist view from the roadway showing a wall location that meets minimum setback requirements.

Determining what the architectural treatment should be on concrete retaining walls exposed to either roadway or neighborhood views can be complicated by the design requirement to consider alternative retaining wall systems. Mn/DOT requires consideration for alternative

wall systems in an effort to reduce project cost. Introduction of alternative wall designs is not without risk, because it puts aesthetic continuity within the highway corridor at risk.

Aesthetically, a consistent visual appearance is desirable for all retaining walls that are visible from the highway. They should either have the same architectural treatment or a hierarchy of detail treatments that can be recognized as belonging to one design theme. Alternative wall designs, generally, are best applied to locations that face the community, where wall sites are often viewed only from a single neighborhood. When retaining walls are connected to bridge wall systems, their final design should be coordinated with Mn/DOT's Office of Bridges and Structures. It is important that the joint location at the transition between these walls is coordinated architecturally, as well as, functionally.

The costs for architectural finishing of retaining wall systems will be distributed in accordance with guidelines established by Mn/DOT for core transportation design. When local demand for design treatments exceed these guidelines, cost sharing by local units of government may be required. Because the aesthetic treatments recommended by the Aesthetic Committee for the retaining wall systems of this project will most likely exceed these guidelines, cost sharing should be anticipated by the City.

AESTHETIC DESIGN RECOMMENDATIONS

3.1 Alignment and Profile

Highway retaining wall alignments generally are designed to follow an adjacent roadway. Thus, the alignments and profiles of most of the wall systems of this project will follow the grade of the mainline roadway. Likewise, wall alignments and profiles on ramps generally will follow the ramp and it's grade. This approach typically results in designs with either straight or gradual alignments and level or sloping top profiles. On this project, the wall systems should have sloping profiles.

3.2 Type

Two types of concrete retaining wall designs are most frequently used for highway construction: cantilever designs and gravity systems. Cantilever walls are typically formed and cast on site. This type of construction, ideally lends itself to some level of architectural finishing that can change plain concrete walls into eye-catching architectural surfaces. Cantilever designs should be used for all of the retaining walls which are visible from the mainline roadways, ramps and frontage roads. The surface treatment recommended by the Aesthetic Committee requires this type of wall construction.

Figure 3-2: Retaining Wall Design Cantilever wall design ideally lends itself to some level of

architectural finishing that can change plain concrete walls into eye-catching architectural surfaces.

Figure 3-2a: Retaining Wall Design Alternative to Figure 3-2. Consider when cost saving changes are desired.

Gravity walls are the second most frequently used type by Mn/DOT. Also called segmental retaining walls (SRW's) or modular block walls, these walls are system designs that use concrete masonry units and geogrids for stabilization because they do not use mortar or steel reinforcement. 'Rockwood', 'Anchor Block', 'Keystone' and 'Versa-Lok' are some of the approved systems of this wall type used by Mn/DOT. Segmental retaining wall systems have become increasingly popular in the last decade, especially with homeowners, because they are a more economical wall design, even though the choice of architectural treatment is very limited. Within the highway corridor, segmental wall systems should only be considered for walls which are <u>not visible</u> from mainline roadways, ramps and frontage roads.

Designers should review all preliminary wall type selections with the Corridor Development Unit in Mn/DOT's Office of Technical Support before designs are completed.

3.3 Size

Retaining wall size is important, because it not only affects the physical design of wall, but also its appearance and relationship with the surrounding area. Whenever possible, short stubby appearing walls of less than 5 feet tall should be avoided. Grading should always be considered the first option for eliminating retaining walls or reducing wall size. Construction of wall planters or terraces are other options for reducing the perceived height of any large retaining wall. Scale relationships can be further influenced by planting the terrace created between individual retaining walls stems.

In an effort to reduce the dominance of the retaining walls located near 19th Street NW and between 6th Street SW and 2nd Street SW for motorists using the parkway route, a continuous vine planter was added by the Aesthetic Committee. See Figures 3-3, 3-4 and 3-4a. This planter will allow native vines to spread and grow onto these walls. Without this feature, planting opportunities in these locations would not exist at the roadway level.

Figure 3-3: Vine Planter Planters were added by the aesthetic Committee at the base of several large wall systems to reduce the dominance of walls by adding greenery and a sculptural trellis system.

Figure 3-4 and 3-4a: Vine Planter Locations This feature should be included in the design of the wall systems located near 19th Street NW and between 6th Street SW and 2nd Street SW.

3.4 Traffic Barrier

All traffic barriers constructed on retaining walls should be designed to match the appearance of the barriers illustrated in Figure 2-22. When a transition from the panel design to slip formed inset segments is required, it should be constructed over the length of one retaining wall panel so that attention is not called to this change. Because of differences involving wall cross-section and concrete mixtures used, retaining walls and traffic barriers are typically constructed separately. The result is the creation of a horizontal construction joint between these features which should be finished so that the texture pattern bridges this joint without undo attention called to it.

3.5 Architectural Finishing Treatment

Natural rock outcrops and local buildings designed with stone served as design inspirations for the wall patterns on this project. These influences are illustrated in Figure 3-5.

All cantilevered retaining walls constructed within the new highway corridor should include an architectural pattern or relief that simulates rough weathered edge and seam face limestone or smooth cut sandstone blocks. The rough textured treatment must be achieved with a custom formliner system designed to create the finished effect of a weathered limestone outcropping. Visually successful stone and rock formliner patterns often require development of multiple liner sections, which can be subsequently mixed or matched with each other to avoid obvious pattern repeats. The pattern(s) developed for this project should be demonstrated and approved through sample panel construction before full scale production, so that the City of Rochester can have an opportunity to participate in adjustment decisions. The smooth textured treatment can be achieved using conventional concrete formwork and application of a cement based finishing system to create the finished effect of cut sandstone blocks.

Figure 3-5: Architectural Surface Treatment Natural rock outcrops and local buildings designed with stone served as design inspirations for the wall patterns on this project.

The layout of the architectural surface treatment should be designed to be compatible with Mn/DOT's standard panel design length of 30'-6". When special circumstance requires wall lengths less than this, panel joints should be located, so that they do not become visually prominent in the final work. Joint layout requires special attention when retaining walls continue or abut bridge wing walls, so that architectural patterns can be blended together in an aesthetically pleasing manner. Early and continuous coordination between designers has been found to be the best strategy to avoiding layout problems.

Payment for finishing rough textured surfaces should be provided in contract documents using the Contract Item: ***"Architectural Surface Treatment, Type _____".***

Payment for finishing smooth textured surfaces should be provided in contract documents as incidental work to the items where utilized.

All segmental retaining walls (SRW's) should be constructed with masonry units having a 3-way split, rock-face texture and tan earth-tone color. Payment for segmental block wall construction should be provided in the contract documents using the Contract Item: ***"Modular Block Retaining Wall".***

Specifications for texture finishing can be obtained from Mn/DOT's Office of Bridges and Structures. Samples of the colors can be obtained from the Corridor Development Unit in Mn/DOT's Office of Technical Support.

3.6 Painting and Finishing

As a unifying design theme within the new highway corridor, the same color finishing treatments described for bridges and traffic barriers should be provided for the cantilevered retaining walls of this project. These colors are illustrated ***Figure 2-32: Design Theme Colors*** included in Chapter 2 of this Design Guide.

Rough textured surfaces should be painted with an approved acrylic stain in a three color tint range characteristic of natural Mankato- Kasota Limestone, including subtle color variations, mineral oxidation and staining. This range should be demonstrated by field testing, so that the Aesthetic Committee can have an opportunity to participate in final color decisions. In areas where graffiti tags may become a problem, consideration should be given to using an anti-graffiti coating following this painting.

Sandstone block textured surfaces and wall caps should be painted with an approved acrylic stain matching Federal Standard 595B Color No.33617 (Light Tan).

Rough textured surfaces simulating limestone outcroppings should be painted with an approved acrylic stain matching Federal Standard 595B Color No.33522 (Dark Tan). Cost permitting, multi-color finishing may be submitted therefore.

Payment for single color finishing should be provided in contract documents as incidental work to the items where utilized.

Payment for multi-color finishing should be provided in contract documents using the Contract Item: ***"Architectural Color System, Type _____".***

Specifications for paint finishing can be obtained from Mn/DOT's Office of Bridges and Structures. Samples of the colors can be obtained from the Corridor Development Unit in Mn/DOT's Office of Technical Support.

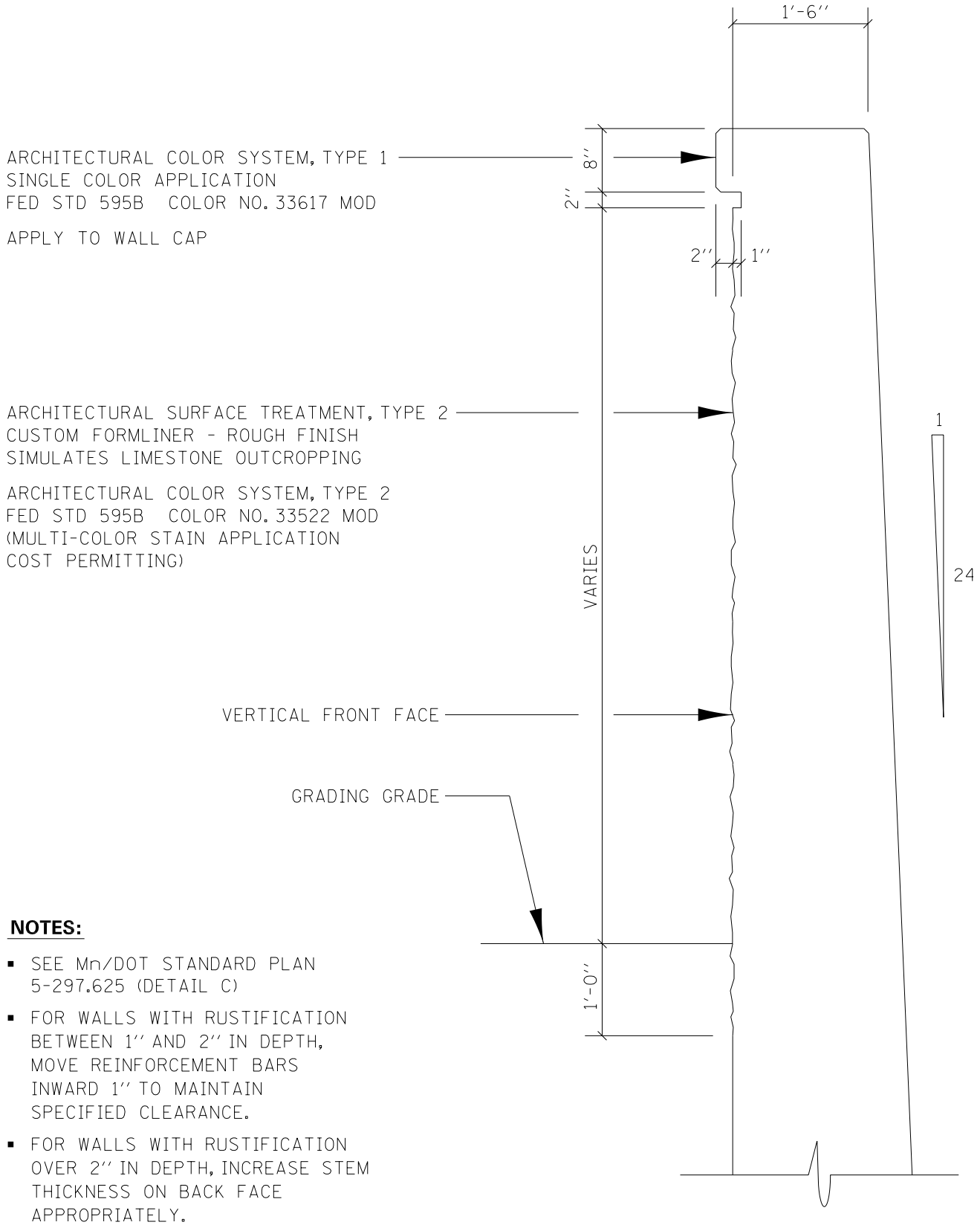
Figure 3-1: Design Visualization
(shown without vine planter)

TH 14/52 Rochester, MN

Motorist View Northbound from TH52 approaching 19th Street NW

Computer Simulation
Produced by Visualization Unit
in Cooperation with Mn/DOT's Rochester District, Final Design

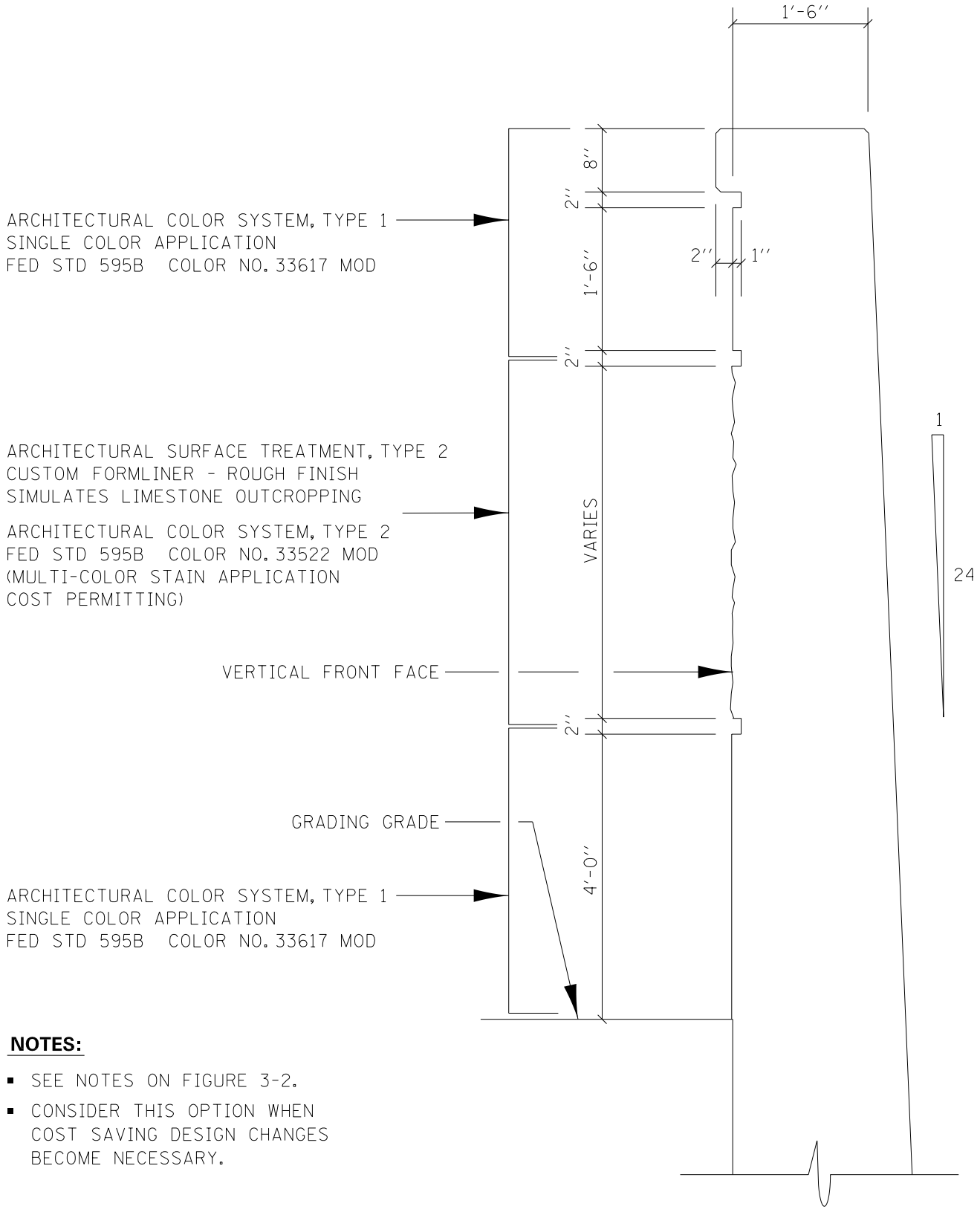
March 15, 2001



NOTES:

- SEE Mn/DOT STANDARD PLAN 5-297.625 (DETAIL C)
- FOR WALLS WITH RUSTIFICATION BETWEEN 1'' AND 2'' IN DEPTH, MOVE REINFORCEMENT BARS INWARD 1'' TO MAINTAIN SPECIFIED CLEARANCE.
- FOR WALLS WITH RUSTIFICATION OVER 2'' IN DEPTH, INCREASE STEM THICKNESS ON BACK FACE APPROPRIATELY.

Figure 3–2: RETAINING WALL DESIGN

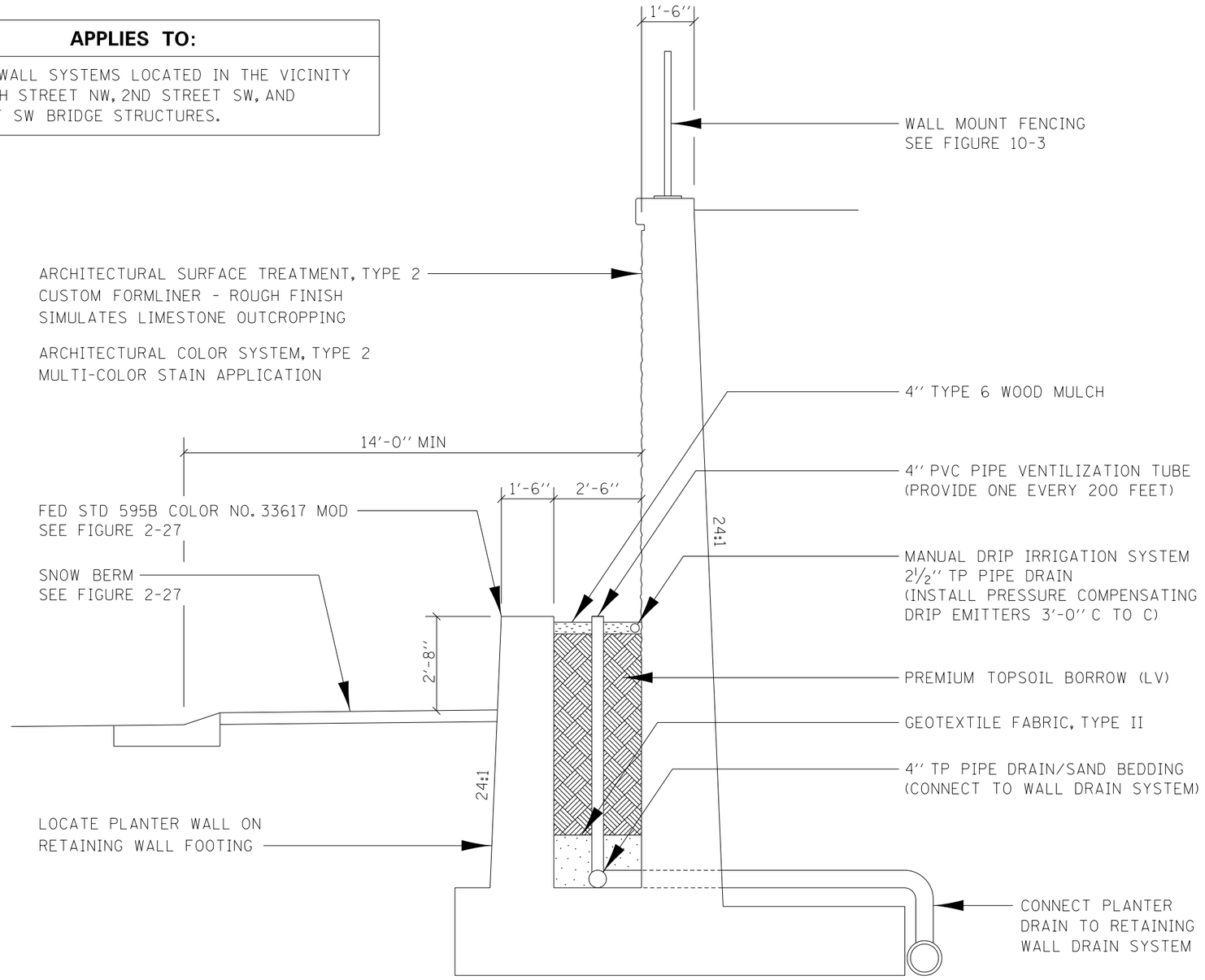


NOTES:

- SEE NOTES ON FIGURE 3-2.
- CONSIDER THIS OPTION WHEN COST SAVING DESIGN CHANGES BECOME NECESSARY.

Figure 3–2a: RETAINING WALL DESIGN
ALTERNATIVE TO FIGURE 3–2

APPLIES TO:
RETAINING WALL SYSTEMS LOCATED IN THE VICINITY OF THE 19TH STREET NW, 2ND STREET SW, AND 6TH STREET SW BRIDGE STRUCTURES.



SECTION
MnDOT STANDARD PLATE 8336A

Figure 3–3: VINE PLANTER

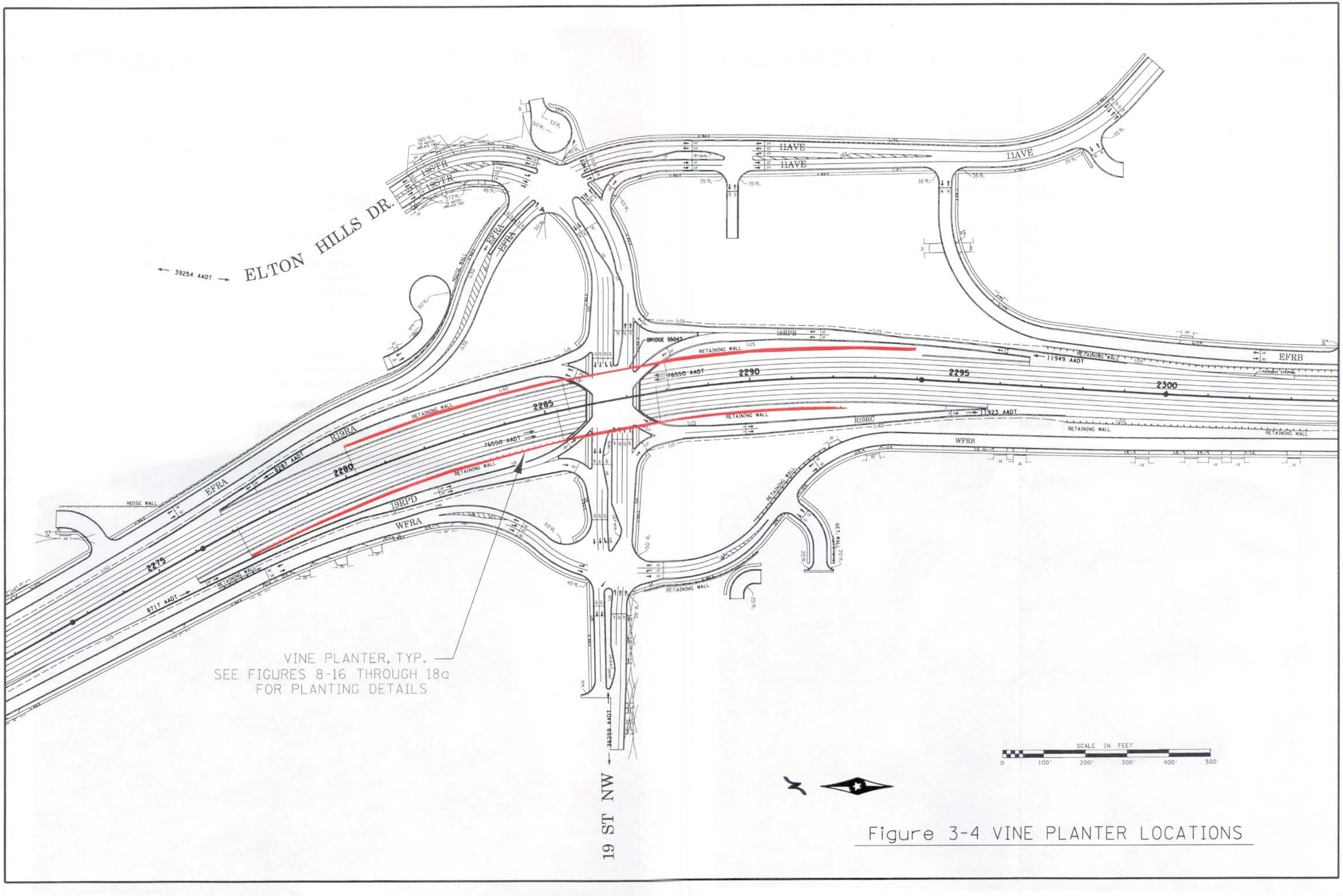


Figure 3-4 VINE PLANTER LOCATIONS

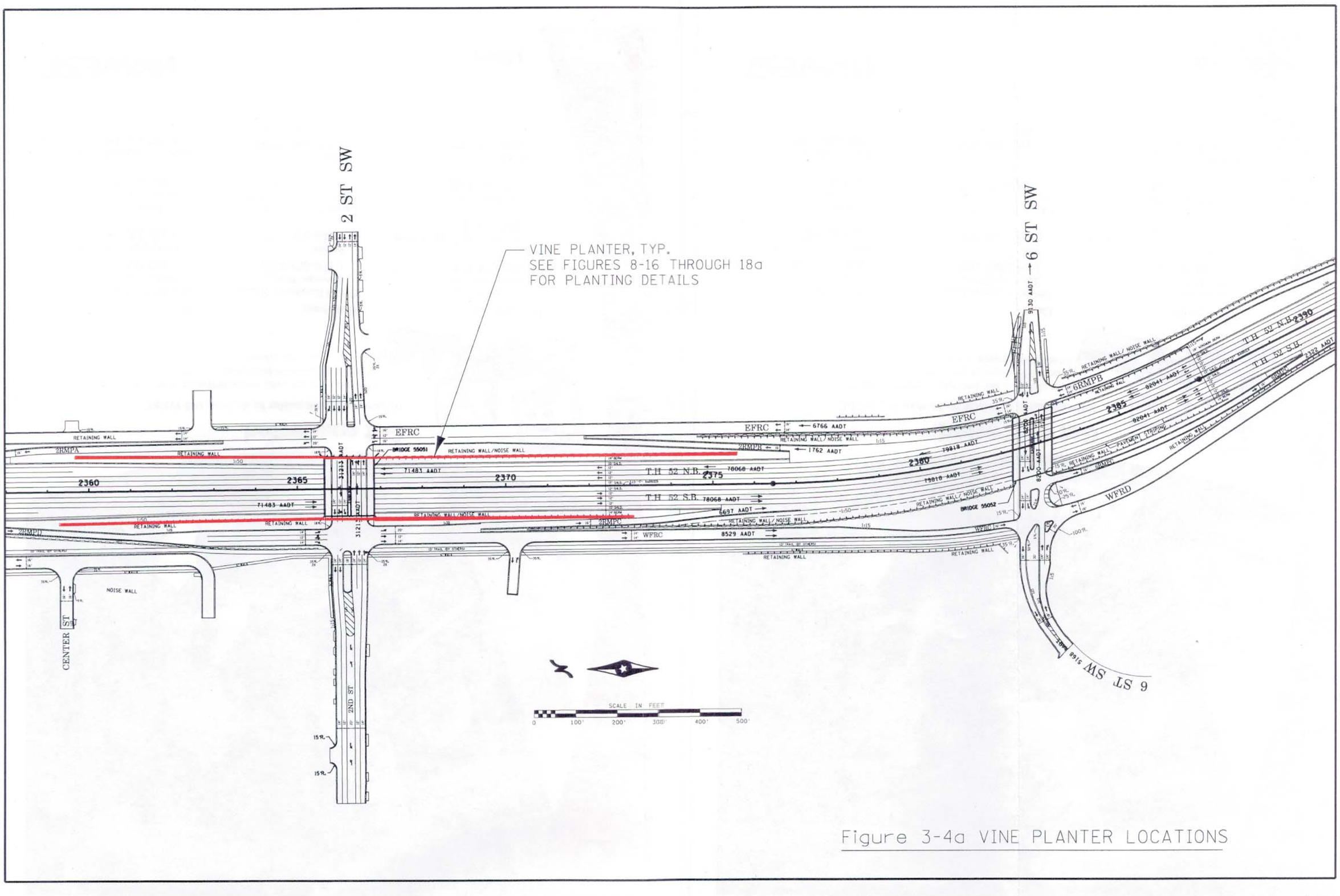
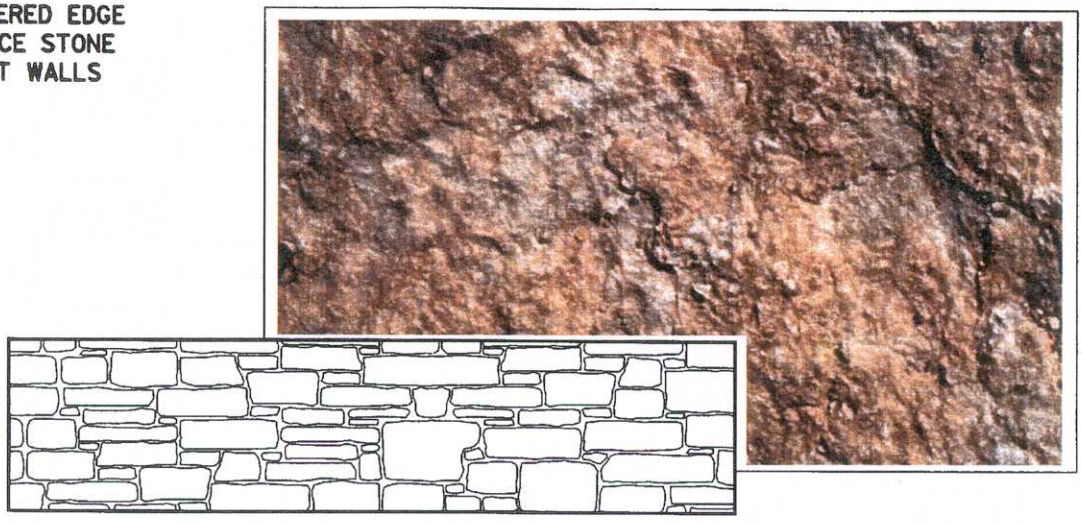


Figure 3-4a VINE PLANTER LOCATIONS

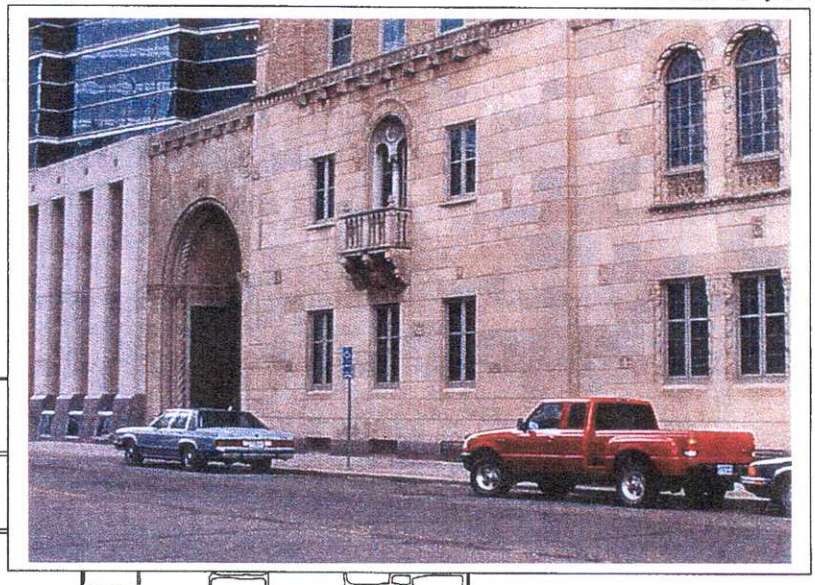
ROUGH WEATHERED EDGE
AND SEAM FACE STONE
FOR ABUTMENT WALLS



CUSTOM PATTERN REQUIRED TO CREATE THE TEXTURED
EFFECT OF A WEATHERED LIMESTONE OUTCROPPING.
(ACTUAL PATTERN REQUIRED IS NOT SHOWN)

PLUMMER BUILDING
ROCHESTER, MN

SMOOTH CUT SANDSTONE
BLOCK WITH FLAT PLANE
FINISH FOR PILASTERS



SANDBLAST PILASTER FOLLOWING FORM RELEASE
TO CREATE THE TEXTURED EFFECT OF
A CARBORUNDUM MACHINE SMOOTH FINISH

Figure 3-5: ARCHITECTURAL FINISHING TREATMENT